CLAIMS:

1. A method for the automated segmentation of lung regions in thoracic images, comprising:

acquiring image data representative of a cross-sectional thoracic image;

establishing a seed point within the cross-sectional thoracic image based on the image data, the seed point corresponding to a major airway;

growing the seed point to segment the major airway;

segmenting the lung regions; and

excluding the major airway from the lung regions.

2. The method of claim 1, further comprising:

determining a first pixel corresponding to a center of mass of the segmented major airway.

3. The method of claim 2, further comprising:

centering, in a subsequent cross-sectional thoracic image, a search region over a second pixel corresponding to the first pixel; and

establishing, in the subsequent cross-sectional thoracic image, another seed point at a lowest density pixel within the search region.

4. The method of claim 1, wherein the major airway is the trachea.

5. The method of claim 1, wherein the major airway is one of the first main stem bronchus and the second main stem bronchus.

6. A method for the automated segmentation of lung regions in thoracic images, comprising:

generating at least one lung contour to segment the lung regions a cross-sectional thoracic image;

identifying fusion of the lung regions;

identifying a cleft point on the lung contour;

determining the average gray level value of pixels along line segments extending from the cleft point to an upper edge of the lung regions;

identifying the anterior junction line based on the line segment with the highest average gray level value; and

extracting from the lung regions the pixels along the anterior junction line to separate the lung regions.

7. The method of claim 6, wherein the step of identifying the anterior junction line comprises:

identifying, within each row of pixels that includes a pixel of the line segment with the highest average gray level value, a pixel with the highest gray level within a predetermined distance of the line segment with the highest average gray level value; and

including within the anterior junction line the pixels identified as having the highest gray level in each row.

8. A method for the automated segmentation of lung regions in thoracic images, comprising:

acquiring image data representative of a cross-sectional thoracic image;

generating initial lung contours to segment the lung regions in the cross-sectional thoracic image;

refining the lung contours by applying a rolling ball filter to the initial lung contours to identify indentations along the initial lung contours;

determining, for each indentation identified by the rolling ball filter, whether the indentation corresponds to the diaphragm; and

preventing the rolling ball filter from including within the segmented lung regions the indentations corresponding to the diaphragm.

9. The method of claim 8, further comprising:

including within the segmented lung regions the indentations identified by the rolling ball filter that do not correspond to the diaphragm.

10. The method of claim 8, wherein the step of identifying indentations corresponding to the diaphragm comprises:

determining, for each indentation identified by the rolling ball filter, a geometric feature;

comparing the geometric feature of each indentation to a threshold; and

determining, for each indentation, whether the indentation corresponds to the diaphragm based on the comparison of the geometric feature to the threshold.

11. A method for the automated segmentation of lung regions in thoracic images, comprising:

acquiring image data representative of plural cross-sectional thoracic images;

generating initial lung contours to segment the lung regions in the plural cross-sectional thoracic images; and

refining the lung contours by applying a three-dimensional rolling ball filter to the initial lung contours in the plural cross-sectional thoracic images.

12. A method for the automated segmentation of lung regions in thoracic images, comprising:

acquiring image data representative of a cross-sectional thoracic image;

generating initial lung contours to segment the lung regions in the cross-sectional thoracic image;

identifying within the lung region at least one portion corresponding to the diaphragm; and

excluding from the lung regions the at least one portion corresponding to the diaphragm.

13. The method of claim 12, wherein the step of identifying comprises:

identifying holes within the lung regions;

determining, for each hole, a geometric feature;

comparing the geometric feature of each hole with a threshold; and

determining, for each hole, whether the hole corresponds to the diaphragm based on the comparison of the geometric feature to the threshold;

wherein the excluding step comprises:

excluding from the lung regions the holes corresponding to the diaphragm.

14. The method of claim 12, further comprising:

identifying an anterior junction line and extracting from the lung regions pixels along the anterior junction line to separate the lung regions.

15. The method of claim 12, further comprising:

identifying within the lung regions portions corresponding to the trachea and main stem bronchi; and

excluding from the lung regions the portions corresponding to the trachea and the main stem bronchi.

16. The method of claim 15, further comprising:

refining the lung contours by applying a rolling ball filter to the lung contours to identify indentations along the lung contours;

determining, for each indentation identified by the rolling ball filter, whether the indentation corresponds to the diaphragm; and

preventing the rolling ball filter from including within the segmented lung regions the indentations corresponding to the diaphragm.

17. The method of claim 16, wherein the step of refining the lung contours by applying a rolling ball filter comprises:

applying a three-dimensional rolling ball filter to the lung contours in the cross-sectional thoracic image and to other lung contours in other cross-sectional thoracic images.

18. A system for the automated segmentation of lung regions in thoracic images, comprising:

a mechanism configured to acquire image data representative of a cross-sectional thoracic image;

a mechanism configured to establish a seed point within the cross-sectional thoracic image based on the image data, the seed point corresponding to a major airway;

a mechanism configured to grow the seed point to segment the major airway;

a mechanism configured to segment the lung regions; and

a mechanism configured to exclude the major airway from the lung regions.

19. The system of claim 18, further comprising:

a mechanism configured to determine a first pixel corresponding to a center of mass of the segmented major airway.

20. The system of claim 19, further comprising:

a mechanism configured to center, in a subsequent cross-sectional thoracic image, a search region over a second pixel corresponding to the first pixel; and

a mechanism configured to establish, in the subsequent cross-sectional thoracic image, another seed point at a lowest density pixel within the search region.

21. The system of claim 18, wherein the major airway is the trachea.

22. The system of claim 18, wherein the major airway is one of the first main stem bronchus and the second main stem bronchus.

23. A system for the automated segmentation of lung regions in thoracic images, comprising:

a mechanism configured to generate at least one lung contour to segment the lung regions a cross-sectional thoracic image;

a mechanism configured to identify fusion of the lung regions;

a mechanism configured to identify a cleft point on the lung contour;

a mechanism configured to determine the average gray level value of pixels along line segments extending from the cleft point to an upper edge of the lung regions;

a mechanism configured to identify the anterior junction line based on the line segment with the highest average gray level value; and

a mechanism configured to extract from the lung regions the pixels along the anterior junction line to separate the lung regions.

24. The system of claim 23, wherein the mechanism configured to identify the anterior junction line comprises:

a mechanism configured to identify, within each row of pixels that includes a pixel of the line segment with the highest average gray level value, a pixel with the highest gray level within a predetermined distance of the line segment with the highest average gray level value; and

a mechanism configured to include within the anterior junction line the pixels identified as having the highest gray level in each row.

25. A system for the automated segmentation of lung regions in thoracic images, comprising:

a mechanism configured to acquire image data representative of a cross-sectional thoracic image;

a mechanism configured to generate initial lung contours to segment the lung regions in the cross-sectional thoracic image;

a mechanism configured to refine the lung contours by applying a rolling ball filter to the initial lung contours to identify indentations along the initial lung contours;

a mechanism configured to determine, for each indentation identified by the rolling ball filter, whether the indentation corresponds to the diaphragm; and

a mechanism configured to prevent the rolling ball filter from including within the segmented lung regions the indentations corresponding to the diaphragm.

26. The system of claim 25, further comprising:

a mechanism configured to include within the segmented lung regions the indentations identified by the rolling ball filter that do not correspond to the diaphragm.

27. The system of claim 25, wherein the mechanism configured to identify indentations corresponding to the diaphragm comprises:

a mechanism configured to determine, for each indentation identified by the rolling ball filter, a geometric feature;

a mechanism configured to compare the geometric feature of each indentation to a threshold; and

a mechanism configured to determine, for each indentation, whether the indentation corresponds to the diaphragm based on the comparison of the geometric feature to the threshold.

28. A system for the automated segmentation of lung regions in thoracic images, comprising:

a mechanism configured to acquire image data representative of plural cross-sectional thoracic images;

a mechanism configured to generate initial lung contours to segment the lung regions in the plural cross-sectional thoracic images; and

a mechanism configured to refine the lung contours by applying a three-dimensional rolling ball filter to the initial lung contours in the plural cross-sectional thoracic images.

29. A system for the automated segmentation of lung regions in thoracic images, comprising:

a mechanism configured to acquire image data representative of a cross-sectional thoracic image;

a mechanism configured to generate initial lung contours to segment the lung regions in the cross-sectional thoracic image;

a mechanism configured to identify within the lung region at least one portion corresponding to the diaphragm; and

a mechanism configured to exclude from the lung regions the at least one portion corresponding to the diaphragm.

30. The system of claim 29, wherein the mechanism configured to identify comprises:

a mechanism configured to identify holes within the lung regions;

a mechanism configured to determine, for each hole, a geometric feature;

a mechanism configured to compare the geometric feature of each hole with a threshold; and

a mechanism configured to determine, for each hole, whether the hole corresponds to the diaphragm based on the comparison of the geometric feature to the threshold;

wherein the mechanism configured to exclude comprises:

a mechanism configured to exclude from the lung regions the holes corresponding to the diaphragm.

31. The system of claim 29, further comprising:

a mechanism configured to identify an anterior junction line and extracting from the lung regions pixels along the anterior junction line to separate the lung regions.

32. The system of claim 29, further comprising:

a mechanism configured to identify within the lung regions portions corresponding to the trachea and main stem bronchi; and

a mechanism configured to exclude from the lung regions the portions corresponding to the trachea and the main stem bronchi.

33. The system of claim 32, further comprising:

a mechanism configured to refine the lung contours by applying a rolling ball filter to the lung contours to identify indentations along the lung contours;

a mechanism configured to determine, for each indentation identified by the rolling ball filter, whether the indentation corresponds to the diaphragm; and

a mechanism configured to prevent the rolling ball filter from including within the segmented lung regions the indentations corresponding to the diaphragm.

34. The system of claim 33, wherein the mechanism configured to refine the lung contours by applying a rolling ball filter comprises:

a mechanism configured to apply a three-dimensional rolling ball filter to the lung contours in the cross-sectional thoracic image and to other lung contours in other cross-sectional thoracic images.

35. A computer readable medium storing computer instructions for the automated segmentation of lung regions in thoracic images, by performing the steps of:

acquiring image data representative of a cross-sectional thoracic image;

establishing a seed point within the cross-sectional thoracic image based on the image data, the seed point corresponding to a major airway;

growing the seed point to segment the major airway;

segmenting the lung regions; and

excluding the major airway from the lung regions.

36. The computer readable medium of claim 35, storing further instructions for performing the step of:

determining a first pixel corresponding to a center of mass of the segmented major airway.

37. The computer readable medium of claim 36, storing further instructions for performing the steps of:

centering, in a subsequent cross-sectional thoracic image, a search region over a second pixel corresponding to the first pixel; and

establishing, in the subsequent cross-sectional thoracic image, another seed point at a lowest density pixel within the search region.

38. The computer readable medium of claim 35, wherein the major airway is the trachea.

39. The computer readable medium of claim 35, wherein the major airway is one of the first main stem bronchus and the second main stem bronchus.

40. A computer readable medium storing computer instructions for the automated segmentation of lung regions in thoracic images, by performing the steps of:

generating at least one lung contour to segment the lung regions a cross-sectional thoracic image;

identifying fusion of the lung regions;

identifying a cleft point on the lung contour;

determining the average gray level value of pixels along line segments extending from the cleft point to an upper edge of the lung regions;

identifying the anterior junction line based on the line segment with the highest average gray level value; and

extracting from the lung regions the pixels along the anterior junction line to separate the lung regions.

41. The computer readable medium of claim 40, wherein the step of identifying the anterior junction line comprises:

identifying, within each row of pixels that includes a pixel of the line segment with the highest average gray level value, a pixel with the highest gray level within a predetermined distance of the line segment with the highest average gray level value; and

including within the anterior junction line the pixels identified as having the highest gray level in each row.

42. A computer readable medium storing computer instructions for the automated segmentation of lung regions in thoracic images, by performing the steps of:

acquiring image data representative of a cross-sectional thoracic image;

generating initial lung contours to segment the lung regions in the cross-sectional thoracic image;

refining the lung contours by applying a rolling ball filter to the initial lung contours to identify indentations along the initial lung contours;

determining, for each indentation identified by the rolling ball filter, whether the indentation corresponds to the diaphragm; and

preventing the rolling ball filter from including within the segmented lung regions the indentations corresponding to the diaphragm.

43. The computer readable medium of claim 42, storing further instructions for performing the step of:

including within the segmented lung regions the indentations identified by the rolling ball filter that do not correspond to the diaphragm.

44. The computer readable medium of claim 42, wherein the step of identifying indentations corresponding to the diaphragm comprises:

determining, for each indentation identified by the rolling ball filter, a geometric feature;

comparing the geometric feature of each indentation to a threshold; and

determining, for each indentation, whether the indentation corresponds to the diaphragm based on the comparison of the geometric feature to the threshold.

45. A computer readable medium storing computer instructions for the automated segmentation of lung regions in thoracic images, by performing the steps of:

acquiring image data representative of plural cross-sectional thoracic images;

generating initial lung contours to segment the lung regions in the plural cross-sectional thoracic images; and

refining the lung contours by applying a three-dimensional rolling ball filter to the initial lung contours in the plural cross-sectional thoracic images.

46. A computer readable medium storing computer instructions for the automated segmentation of lung regions in thoracic images, by performing the steps of:

acquiring image data representative of a cross-sectional thoracic image;

generating initial lung contours to segment the lung regions in the cross-sectional thoracic image;

identifying within the lung region at least one portion corresponding to the diaphragm; and

excluding from the lung regions the at least one portion corresponding to the diaphragm.

47. The computer readable medium of claim 46, wherein the step of identifying comprises:

identifying holes within the lung regions;

determining, for each hole, a geometric feature;

comparing the geometric feature of each hole with a threshold; and

determining, for each hole, whether the hole corresponds to the diaphragm based on the comparison of the geometric feature to the threshold;

wherein the excluding step comprises:

excluding from the lung regions the holes corresponding to the diaphragm.

48. The computer readable medium of claim 46, storing further instructions for performing the step of:

identifying an anterior junction line and extracting from the lung regions pixels along the anterior junction line to separate the lung regions.

49. The computer readable medium of claim 46, storing further instructions for performing the steps of:

identifying within the lung regions portions corresponding to the trachea and main stem bronchi; and

excluding from the lung regions the portions corresponding to the trachea and the main stem bronchi.

50. The computer readable medium of claim 49, storing further instructions for performing the steps of:

refining the lung contours by applying a rolling ball filter to the lung contours to identify indentations along the lung contours;

determining, for each indentation identified by the rolling ball filter, whether the indentation corresponds to the diaphragm; and

preventing the rolling ball filter from including within the segmented lung regions the indentations corresponding to the diaphragm.

51. The computer readable medium of claim 50, wherein the step of refining the lung contours by applying a rolling ball filter comprises:

applying a three-dimensional rolling ball filter to the lung contours in the cross-sectional thoracic image and to other lung contours in other cross-sectional thoracic images.